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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

LAKE MACBRIDE

JOHNSON COUNTY

IOWA

EPA REGION VII

WORKING PAPER No. 500

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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REPORT
ON
LAKE MACBRIDE
JOHNSON COUNTY
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WORKING PAPER No. 500

WITH THE COOPERATION OF THE
IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY
AND THE
IOWA NATIONAL GUARD
AUGUST, 1976

CONTENTS

	Page
Foreword	ii
List of Iowa Study Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	4
III. Lake Water Quality Summary	5
IV. Nutrient Loadings	9
V. Literature Reviewed	14
VI. Appendices	15

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Iowa Department of Environmental Quality for professional involvement, to the Iowa National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Water Quality Division of the Department of Environmental Quality provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

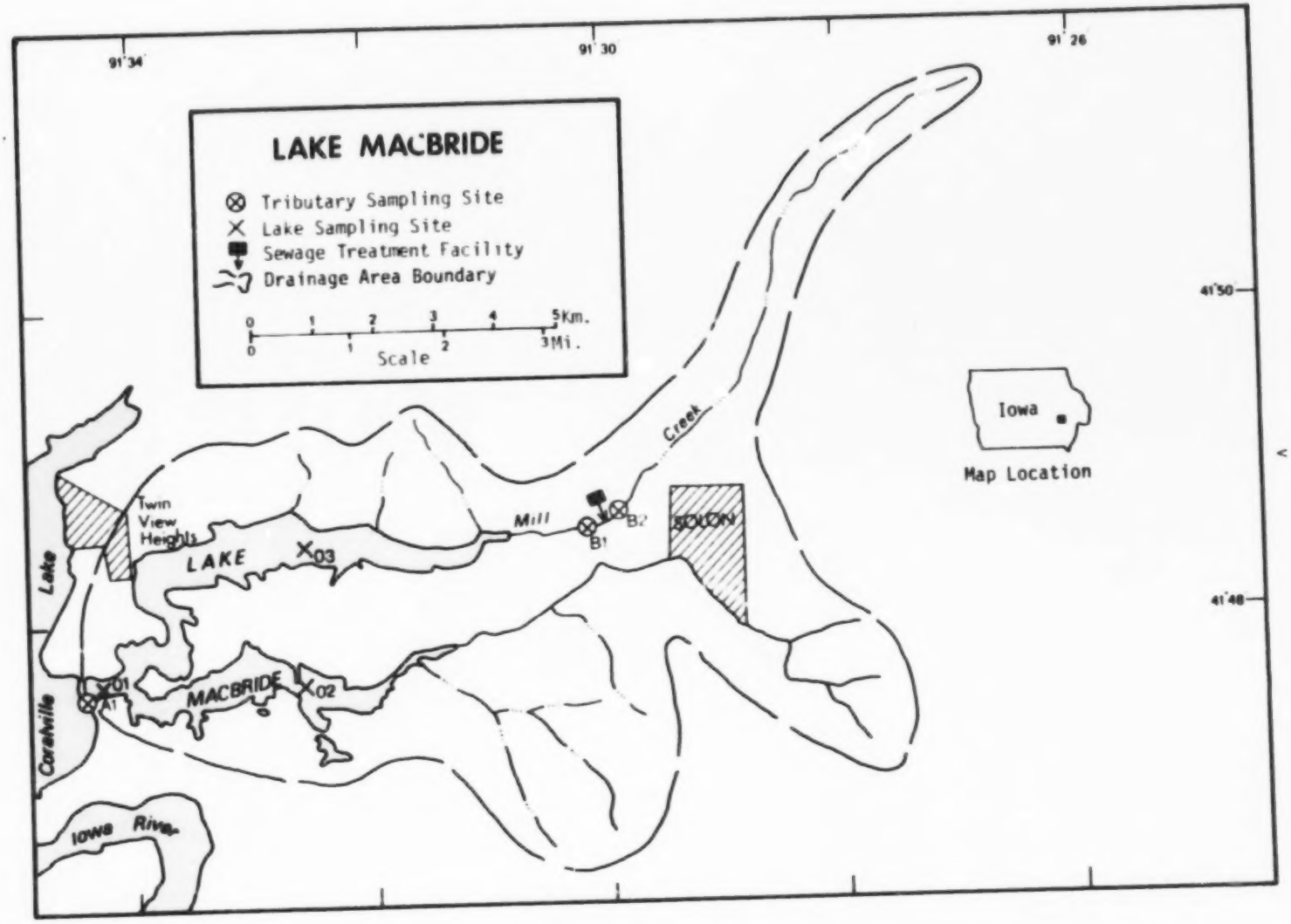
Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

LAKE NAME	COUNTY
Ahquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson


LAKE MACBRIDE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
0 1 2 3 4 5Km.
0 1 2 3Mi.
Scale
91°34'
91°30'
91°26'
41°50'
41°48'
Iowa
Map Location
Twin View Heights
LAKE
MACBRIDE
Lake
Coralville
Mill
Creek
IOWA River
SOUTH
X01
X02
X03
A1
B1
B2

LAKE MACBRIDE

STORET NO. 1907

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake MacBride is eutrophic. It ranked tenth in overall trophic quality when the 15 Iowa lakes and reservoirs sampled in 1974 were compared using a combination of six lake parameters*. Five of the water bodies had less median total phosphorus, four had less and two had the same median orthophosphorus, 13 had less median inorganic nitrogen, seven had less mean chlorophyll a, and four had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at sampling station 1 in July and September and at station 2 in July.

Survey limnologists noted areas of high turbidity in the south arm of the lake and observed beds of macrophytes in the vicinity of station 1. An algal bloom was in progress throughout the lake in September.

B. Rate-Limiting Nutrient:

Due to significant changes in nutrient levels in the samples, the algal assay results are not representative of conditions in the lake at the times the samples were collected (04/18/74 and 09/24/74).

The lake data indicate phosphorus limitation in April and September.

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* See Appendix A.

C. Nutrient Controllability:

1. Point sources--The only known point source of phosphorus to Lake MacBride is the Solon wastewater treatment plant which contributed nearly 42% of the total load reaching the reservoir during the sampling year. Most of the sewage from the MacBride State Park facilities is transported out of the drainage basin for treatment and disposal with the remainder being treated in septic tanks situated well away from the lake*.

During the sampling year, the lake received a total phosphorus loading over one and a half times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 13). It is calculated that 90% phosphorus removal at the Solon wastewater treatment plant would reduce the total phosphorus loading to 0.42 g/m^2/year. This loading would still exceed Vollenweider's eutrophic loading, and it is questionable whether the reduction would result in a significant improvement in the trophic condition of the lake.

2. Non-point sources--It is estimated that non-point sources contributed about 52% of the total phosphorus load to Lake MacBride during the sampling year. Mill Creek, the major tributary, contributed about 16% of the total phosphorus load.

Reportedly, many ducks utilize Lake MacBride during spring and fall migrations (Anonymous, 1974). However, waterfowl counts are

* Kenyon, 1976.

not made routinely at the lake (Harrison, 1976), and the significance of the nutrient contributions of migrating ducks cannot be assessed.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 3.84 kilometers^2.
2. Mean depth: 7.3 meters.
3. Maximum depth: 14.2 meters.
4. Volume: 28.032 x 10^6 m^3.
5. Mean hydraulic retention time: 2.2 years.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Mill Creek (B-1)	21.5	0.13
Minor tributaries & immediate drainage -	44.6	0.28
Totals	66.1	0.41

2. Outlet -

MacBride Dam spillway	69.9**	0.41

C. Precipitation***:

1. Year of sampling: 74.5 centimeters.
2. Mean annual: 85.3 centimeters.

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† Table of metric conversions--Appendix B.
†† Harrison, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Lake MacBride was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at three stations on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 12.5 meters at station 1, 4.0 meters at station 2, and 3.4 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE MACBRIDE
STORET CODE 1907

	1ST SAMPLING (6/18/74) 3 SITES			2ND SAMPLING (7/ 3/74) 3 SITES			3RD SAMPLING (9/24/74) 3 SITES		
PARAMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
TEMP (C)	7.8 - 12.0	10.2	10.2	11.6 - 25.5	21.5	23.5	12.0 - 17.7	16.3	16.8
DISS OXY (MG/L)	8.8 - 10.6	9.3	9.6	8.6 - 8.2	5.3	7.2	0.0 - 11.6	6.4	7.6
CNUCTVY (MCROMO)	233. - 293.	258.	252.	173. - 365.	298.	315.	113. - 259.	233.	245.
PH (STAND UNITS)	7.7 - 8.5	8.1	8.1	7.3 - 8.9	8.0	8.1	6.8 - 8.6	7.8	8.0
TOT ALK (MG/L)	122. - 148.	130.	125.	****** -**********			114. - 173.	133.	127.
TOT P (MG/L)	0.029 - 0.186	0.081	0.058	****** -**********			0.021 - 0.347	0.090	0.063
ORTHO P (MG/L)	0.006 - 0.036	0.012	0.009	****** -**********			0.006 - 0.016	0.011	0.010
NO2+NO3 (MG/L)	1.510 - 3.500	2.235	2.100	****** -**********			0.040 - 0.850	0.555	0.625
AMMONIA (MG/L)	0.060 - 0.520	0.293	0.240	****** -**********			0.030 - 4.160	0.711	0.160
KJEL N (MG/L)	0.900 - 1.100	1.000	1.000	****** -**********			0.780 - 4.600	1.475	1.100
INORG N (MG/L)	2.030 - 3.930	2.529	2.390	****** -**********			0.470 - 4.280	1.266	0.955
TOTAL N (MG/L)	2.580 - 4.600	3.235	3.095	****** -**********			1.120 - 4.648	2.030	1.850
CHLRPTL A (UG/L)	7.1 - 14.7	10.7	10.4	4.7 - 11.2	8.9	10.9	13.7 - 46.4	31.5	34.5
SECCHI (METERS)	0.6 - 1.7	1.0	0.8	0.9 - 1.8	1.3	1.2	0.5 - 1.3	0.8	0.7

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/18/74	1. Centric diatoms	8,889
	2. Flagellates	3,081
	3. *Cryptomonas sp.*	652
	4. *Aphanizomenon sp.*	593
	5. *Stephanodiscus sp.*	474
	Other genera	118
	Total	13,807
07/03/74	1. *Melosira sp.*	4,275
	2. *Oocystis sp.*	792
	3. Flagellates	317
	4. *Cryptomonas sp.*	198
	5. *Lepocinclis sp.*	119
	Other genera	315
	Total	6,016
09/24/74	1. *Melosira sp.*	5,076
	2. Flagellates	1,232
	3. Pennate diatoms	859
	4. *Cryptomonas sp.*	672
	5. *Synedra sp.*	635
	Other genera	1,268
	Total	9,742

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/18/74	1	7.1
	2	14.7
	3	10.4
07/03/74	1	11.2
	2	4.7
	3	10.9
09/24/74	1	13.7
	2	34.5
	3	46.4

C. Limiting Nutrient Study:

Significant changes in nutrient levels occurred in the assay samples prior to the beginning of the assays, and the results are not indicative of conditions in the lake at the times the samples were taken (04/18/74 and 09/24/74).

The lake data indicate phosphorus limitation in April and September (the mean inorganic nitrogen/orthophosphorus ratios were 211/1 and 115/1, respectively).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Iowa National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April, May, and June when two samples were collected. Sampling was begun in August, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Iowa District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for the lake outlet were calculated using mean concentrations and the mean flow at station A-1. Nutrient loads for Mill Creek were calculated using the mean concentrations at sampling station B-2 and the mean flow at station B-1 (nutrient concentrations at station B-1 were not used because of incomplete mixing of the Solon wastewater treatment plant effluent in the creek at the sampling point; however, B-1 data are included in Appendix E). Nutrient loads shown for Mill Creek do not include loads contributed by the wastewater treatment plant.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads in Mill Creek, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

The operator of the Solon wastewater treatment plant provided monthly effluent samples but could not provide corresponding flow data, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year. Results of analyses of the Solon samples are included in Appendix E.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Solon	950	trickling filter	359.6**	Mill Creek

2. Known industrial - None

* Treatment plant questionnaire.
** Estimated at 0.3785 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Mill Creek	465	18.0
b. Minor tributaries & immediate drainage (non-point load) -	980	37.9
c. Known municipal STP's -		
Solon	1,075	41.6
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	65	2.5
Total	2,585	100.0

2. Outputs -

Lake outlet - MacBride Dam spillway 725

3. Net annual P accumulation - 1,860 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Mill Creek	18,705	28.8
b. Minor tributaries & immediate drainage (non-point load) -	38,800	59.8
c. Known municipal STP's -		
Solon	3,230	5.0
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	4,145	6.4
Total	64,880	100.0

2. Outputs -

Lake outlet - MacBride Dam spillway	28,590

3. Net annual N accumulation - 36,290 kg.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Mill Creek	22	870

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.67	0.48	16.9	9.5

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake MacBride:

"Dangerous" (eutrophic loading)	0.36
"Permissible" (oligotrophic loading)	0.18

V. LITERATURE REVIEWED

Anonymous, 1974. Lake MacBride State Park brochure. IA Cons. Comm., Des Moines.

Harrison, Harry M., 1975. Personal communication (lake morphometry). IA Cons. Comm., Des Moines.

_____, 1976. Personal communication (numbers of waterfowl at Lake MacBride). IA Cons. Comm., Des Moines.

Kenyon, Lawrence (Park Ranger), 1976. Personal communication (State Park sewage disposal system). MacBride State Park, Solon.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1901	LAKE ACQUABI	0.062	0.335	469.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	6.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DARLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.008
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NU
1901	LAKE ACQUABI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE DARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	68 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACQUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	296
10	1907	LAKE MACBRIDE	263
11	1914	VIKING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR IOWA 12/23/75

LAKE CODE 1907 MACBRIDE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 69.9

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1907A1	69.9	0.31	0.73	0.89	0.57	0.63	0.59	0.36	0.18	0.17	0.13	0.23	0.13	0.41
1907B1	21.5	0.09	0.23	0.27	0.17	0.19	0.18	0.11	0.06	0.05	0.04	0.07	0.04	0.13
1907ZZ	48.4	0.21	0.51	0.62	0.39	0.44	0.41	0.25	0.13	0.12	0.09	0.16	0.09	0.28

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 69.9
SUM OF SUB-DRAINAGE AREAS = 70.8
TOTAL FLOW IN = 4.92
TOTAL FLOW OUT = 4.92

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1907A1	8	74	0.13	18	0.18				
	9	74	0.14	8	0.15				
	10	74	0.09	20	0.08				
	11	74	0.12	19	0.14				
	12	74	0.57	19	1.08				
	1	75	0.45	18	0.28				
	2	75	0.27	9	0.17				
	3	75	0.68	15	1.84				
	4	75	0.65	7	0.82	21	0.45		
	5	75	0.27	5	0.31	19	0.23		
	6	75	0.15	3	0.20	19	0.15		
	7	75	0.03	6	0.06				
1907B1	8	74	0.04	18	0.03				
	9	74	0.05	8	0.05				
	10	74	0.03	20	0.03				
	11	74	0.04	19	0.05				
	12	74	0.28	19	0.37				
	1	75	0.14	18	0.09				
	2	75	0.08	9	0.05				
	3	75	0.21	15	0.57				
	4	75	0.20	7	0.25	21	0.14		
	5	75	0.08	5	0.09	19	0.07		
	6	75	0.05	3	0.07	19	0.05		
	7	75	0.01	6	0.02				
1907ZZ	8	74	0.18						
	9	74	0.11						
	10	74	0.07						
	11	74	0.10						
	12	74	0.42						
	1	75	0.31						
	2	75	0.18						
	3	75	0.45						
	4	75	0.45						
	5	75	0.19						
	6	75	0.11						
	7	75	0.02						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

198701
41 47 35.0 091 34 23.0
LAKE MACBRIDE
19103 IOWA

11EPALES
3

2111202
0045 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/18	10 10	0000	9.4		66	239	8.35	125	0.270	1.000	1.830	0.008
	10 10	0005	9.4	10.0		240	8.10	124	0.320	1.000	1.760	0.007
	10 10	0015	8.8	9.6		237	8.00	125	0.360	0.900	1.600	0.006
	10 10	0040	7.8	8.8		233	7.90	127	0.520	1.100	1.510	0.007
74/07/03	10 40	0000	23.5	7.8	72	304	8.30					
	10 40	0005	23.1	5.8		299	8.10					
	10 40	0015	19.0	2.2		273	7.50					
	10 40	0025	14.7	0.6		233	7.60					
	10 40	0040	11.6	0.8		173	7.30					
74/09/24	11 00	0000	17.7	6.2	52	243	7.51	117	0.260	1.100	0.840	0.009
	11 00	0005	17.6	6.0		113	7.57	114	0.250	0.800	0.850	0.010
	11 00	0015	17.6	6.0		235	7.37	116	0.360	0.800	0.820	0.009
	11 00	0025	17.0	0.6		245	6.95	132	0.910	1.500	0.520	0.012
	11 00	0030	13.9	0.0		223	6.83	144	2.320	2.600	0.060	0.016
	11 00	0041	12.0	0.0		223	6.77	173	4.160	4.600	0.040	0.016

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/18	10 10	0000	0.042	7.1	
	10 10	0005	0.036		
	10 10	0015	0.030		
	10 10	0040	0.029		
74/07/03	10 40	0000		11.2	
	10 40	0012			1.0
74/09/24	11 00	0000	0.021	13.7	
	11 00	0001			50.0
	11 00	0005	0.034		
	11 00	0009			1.0
	11 00	0015	0.027		
	11 00	0025	0.054		
	11 00	0030	0.071		
	11 00	0041	0.347		

STORET RETRIEVAL DATE 75/12/23

190702
41 47 36.0 091 32 41.0
LAKE MACBRIDE
19103 IOWA

11EPALES
3

2111202
0017 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/18	10 35	0000	12.0		24	293	8.50	140	0.060	1.100	2.700	0.009
	10 35	0005	11.5	10.6		292	8.20	141	0.150	0.900	2.860	0.010
	10 35	0013	9.1	8.0		287	7.70	148	0.430	1.100	3.500	0.036
74/07/03	11 00	0000	25.0	7.8	36	365	8.20					
	11 00	0005	24.3	7.2		365	7.90					
	11 00	0010	19.3	1.6		315	7.30					
74/09/24	11 40	0000	16.6	9.6	28	259	8.39	145	0.070	0.900	0.420	0.006
	11 40	0005	16.5	9.0		259	8.37	147	0.050	0.800	0.420	0.009
	11 40	0011	16.4	9.0		259	8.39	143	0.050	0.700	0.420	0.010

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/18	10 35	0000	0.095	14.7	
	10 35	0005	0.095		
	10 35	0013	0.106		
74/07/03	11 00	0000		4.7	
	11 00	0007			1.0
74/09/24	11 40	0000	0.062	34.5	
	11 40	0005	0.055		
	11 40	0011	0.065		

STORET RETRIEVAL DATE 75/12/23

190703
41 48 25.0 091 32 40.0
LAKE MACBRIDE
19103 IOWA

11EPALES
3

2111202
0015 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/18	11 00	0000	11.6		30	253	8.20	122	0.240	0.980	2.310	0.015
	11 00	0005	11.5	8.2		255	8.10	122	0.280	1.000	2.220	0.014
	11 00	0011	11.0	9.8		250	8.10	123	0.300	1.000	1.980	0.013
74/07/03	11 20	0000	25.5	8.2	48	319	8.90					
	11 20	0005	25.3	7.8		320	8.70					
	11 20	0011	25.0	8.2		317	8.50					
74/09/24	14 00	0000	16.8	11.6	18	249	8.63	122	0.030	1.100	0.730	0.010
	14 00	0005	16.8	9.6		245	8.53	119	0.040	1.100	0.770	0.011
	14 00	0008	16.8	9.6		247	8.61	120	0.030	1.700	0.770	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/18	11 00	0000	0.062	10.4	
	11 00	0005	0.061		
	11 00	0011	0.056		
74/07/03	11 20	0000		10.9	
74/09/24	14 00	0000	0.092	46.4	
	14 00	0001			50.0
	14 00	0004			1.0
	14 00	0005	0.116		
	14 00	0008	0.136		

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/01/27

1907A1
41 47 35.0 091 34 30.0
LK MACBRIDE DAM OUTLET
19183 7.5 ELY
O/LAKE MACBRIDE
SPILLWAY OF LAKE MACBRIDE DAM
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	15 37		1.680	0.800	0.050	0.017	0.035
74/09/08	11 05		1.040	0.800	0.050	0.010	0.025
74/10/20	11 30		0.600	1.300	0.420	0.005	0.020
74/11/19	15 15		0.610	0.900	0.430	0.010	0.030
74/12/19	14 20		0.660	1.500	0.395	0.005K	0.020
75/01/18	09 40		0.850	1.200	0.296	0.005	0.030
75/02/09	10 08		0.900	1.200	0.320	0.016	0.016
75/03/15	12 45		1.100	0.900	0.240	0.005K	0.020
75/04/07	16 00		1.350	1.625	0.380	0.080	0.140
75/04/21	10 00		1.450	2.700	0.400	0.040	0.170
75/05/05	14 10		0.330	2.000	0.025	0.015	0.060
75/05/19	19 55		1.400	1.150	0.085	0.010	0.130
75/06/03	21 00		1.250	0.900	0.045	0.015	0.050
75/06/19	20 20		0.930	0.700	0.045	0.005	0.040
75/07/06	17 30		0.340	1.000	0.145	0.020	0.050

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/01/27

190781
41 48 40.0 091 30 15.0
MILL CREEK
19 7.5 ELY
T/LAKE MACBRIDE
ST HWY 382 BRDG BELOW SOLON STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	14 55		5.200	1.100	0.250	0.290	0.525
74/09/08	10 40		3.360	2.300	0.975	0.560	0.710
74/10/20	11 06		3.300	5.300	1.720	0.975	2.300
74/11/19	15 01		4.000	2.500	0.825	0.530	0.725
74/12/19	14 00		5.290	1.360	0.097		0.205
75/01/18	09 55			1.300	0.480	0.230	0.340
75/03/15	12 19		3.450	9.000	1.570	0.975	2.800
75/04/07	15 45		6.900	1.350	0.300	0.190	0.360
75/04/21	09 35		6.000	2.700	0.620	0.250	0.300
75/05/05	13 45		5.400	2.600	0.640	0.360	0.560
75/05/19	19 32		4.200	3.150	1.150	1.000	1.150
75/06/03	20 35		3.800	0.800	0.725	0.615	0.820
75/06/19	20 05		3.600	2.400	0.925	0.840	1.050
75/07/06	17 05		1.600	2.350	0.950	0.830	1.080

STORET RETRIEVAL DATE 76/01/27

190782
41 48 40.0 091 30 05.0
MILL CREEK
19 7.5 ELY
T/LAKE MACBRIDE
LGHT DTY RD BRDG ABOVE SOLON STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	15 15		5.300	0.700	0.060	0.090	0.160
74/09/08	10 30		2.640	0.500	0.025	0.045	0.045
74/10/20	10 55		2.640	0.800	0.035	0.035	0.050
74/11/19	14 50		4.000	0.600	0.060	0.080	0.090
74/12/19	13 55		5.240	1.200	0.124	0.040	0.190
75/01/18	10 05		0.025	0.600	0.088	0.040	0.080
75/03/15	12 07		3.670	1.000	0.190	0.050	0.115
75/04/07	15 35		7.200	1.450	0.195	0.060	0.160
75/04/21	09 25		6.300	1.100	0.110	0.040	0.060
75/05/05	13 30		0.270	1.150	0.035	0.050	0.050
75/05/19	19 25		4.600	1.600	0.080	0.060	0.090
75/06/03	20 30		4.000	0.650	0.040	0.105	0.287
75/06/19	19 55		3.500	1.000	0.110		0.100
75/07/06	16 55		1.100	1.050	0.045	0.070	0.110

STORET RETRIEVAL DATE 76/01/27

1907AA TF1907AA P000950
41 34 38.0 093 33 20.0
SOLON
19183 7.5 SOLON IA
T/LAKE MCBRIDE
MILL CREEK
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/09/27	08 00								
CP(T)-			10.100	17.000	4.950	4.600	5.100	0.126	0.128
74/09/27	16 00								
74/10/25	06 00								
CP(T)-			8.000	16.000	2.500	6.600	9.400		
74/10/25	18 00								
74/12/27	08 00								
CP(T)-			6.000	16.000	3.000	4.300	4.400		
74/12/27	16 00								
75/01/31	08 00								
CP(T)-			2.880	23.000	7.750	5.300	8.800		
75/01/31	16 00								
75/02/28	08 00								
CP(T)-			2.240	23.000	7.000	3.900	5.400		
75/02/28	16 00								
75/03/31	08 00								
CP(T)-			2.320	12.000	0.320	2.560	3.100		
75/03/31	16 00								
75/04/28	08 00								
CP(T)-			2.200	13.500	1.550	3.900	4.400		
75/04/28	16 00								
75/05/30	08 00								
CP(T)-			2.500	11.000	0.380	3.150	3.400	0.082	
75/05/30	16 00								
75/06/27			9.200	15.000	0.990	4.600	5.775		
75/07/25	08 00								
CP(T)-			9.000	15.000	1.350	8.700	9.100		
75/07/25	16 00								
75/09/26	08 00								
CP(T)-			7.650	17.000	3.500	7.200	9.000		
75/09/26	16 00								
75/10/30	08 00								
CP(T)-			6.300	20.000	3.400	8.800	10.500		
75/10/30	16 00								